all limit determined by the quantum-coherence time of the $^{199}Hg^+$ ions and the characteristic stability time of the microwave source.

The following results have been reported from experiments performed on a LITS to demonstrate these modifications: The best short-term fractional frequency instability achieved with a typical microwave-interrogation time of 6 s in the unmodified bimodal lamp cycle was between 7 and $10 \times 10^{-14}\tau^{-1/2}$, where τ is the averaging (observation) time in seconds. The use of the modified lamp mode and a microwave-interrogation time of 30 s resulted in a short-term fractional instability of 5 and $10 \times 10^{-14}\tau^{-1/2}$. To put these numbers in perspective, it was calculated that the time for the LITS to settle to a fractional frequency instability of 10^{-16} would be about 8.4 days without the modifications or 2.9 days with the modifications.

This work was done by Eric Burt and Robert Tjoelker of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-44271

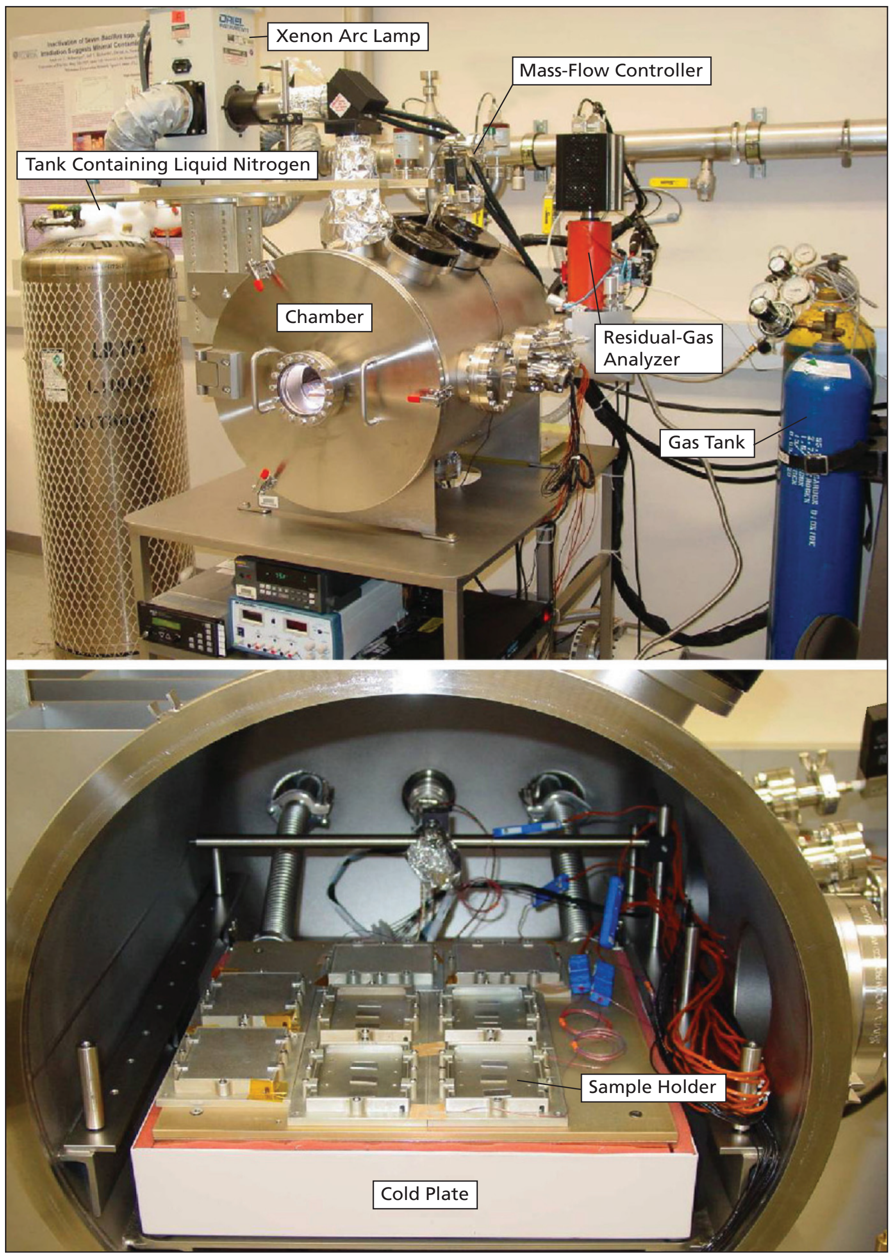
Chamber for Simulating Martian and Terrestrial Environments

Temperature, pressure, and simulated solar radiation can be controlled over wide ranges.

John F. Kennedy Space Center, Florida

An apparatus for simulating the environment at the surface of Mars has been developed. Within the apparatus, the pressure, gas composition, and temperature of the atmosphere; the incident solar visible and ultraviolet (UV) light; and the attenuation of the light by dust in the atmosphere can be simulated accurately for any latitude, season, or obliquity cycle over the entire geological history of Mars. The apparatus also incorporates instrumentation for monitoring chemical reactions in the simulated atmosphere. The apparatus can be used for experiments in astrobiology, geochemistry, aerobiology, and aerochemistry related to envisioned robotic and human exploration of Mars. Moreover, the apparatus can be easily adapted to enable similar experimentation under environmental conditions of (1) the surfaces of moons, asteroids, and comets, and (2) the upper atmospheres of planets other than Mars: in particular, it can be made to simulate conditions anywhere in the terrestrial atmosphere at altitudes up to about 100 km.

The apparatus (see figure) includes a cylindrical stainless-steel chamber, wherein the simulated atmospheric pressure is maintained between set points by means of a vacuum pump and a throttle valve controlled by an electronic pressure controller. The pressure can be set at any level from ambient down to 0.1 mb (100 Pa). A commercially available Martian-atmosphere-simulating mixture of gases (95.54% CO_2 + 2.7% N_2 + 1.6% Ar + 0.13% O_2 + 0.03% H_2O) is delivered from a tank to the chamber through a mass-flow controller. The primary temperature-control system is a commercially available unit that includes a cold plate in the chamber and that utilizes liquid nitrogen to reach the



This **Laboratory Apparatus** reproduces, inside the chamber, environmental conditions like those on the Martian surface or in the upper terrestrial atmosphere.

lowest temperatures. The temperature-control system can be programmed to maintain any temperature between –100 and +160 °C and/or to impose diurnal heating and cooling cycles.

Ultraviolet (UV), visible (VIS), and near-infrared light (IR) are supplied to the inside of the chamber through fused-silica glass ports. In the original Mars version of the apparatus, the UV light is generated by a xenon-arc lamp and can be adjusted to any realistic current or ancient Martian UV flux density. To suppress spurious thermal IR radiation, a water filter between the xenon-arc lamp and the chamber attenuates near- and mid-infrared light. The light-attenuating effects of dust in the atmosphere are simulated by means of a series of neutral-density filters, ranging from an optical depth of 0.1 (representing a dust-free sky) to an optical depth of 3.5 (representing a global dust storm).

This work was done by Andrew C. Schuerger of the University of Florida for Kennedy Space Center. Further information is contained in a TSP (see page 1). ***KSC-13190***